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19.5 / 20

Palestine Technical University Kadouri

College of Engineering and Technology

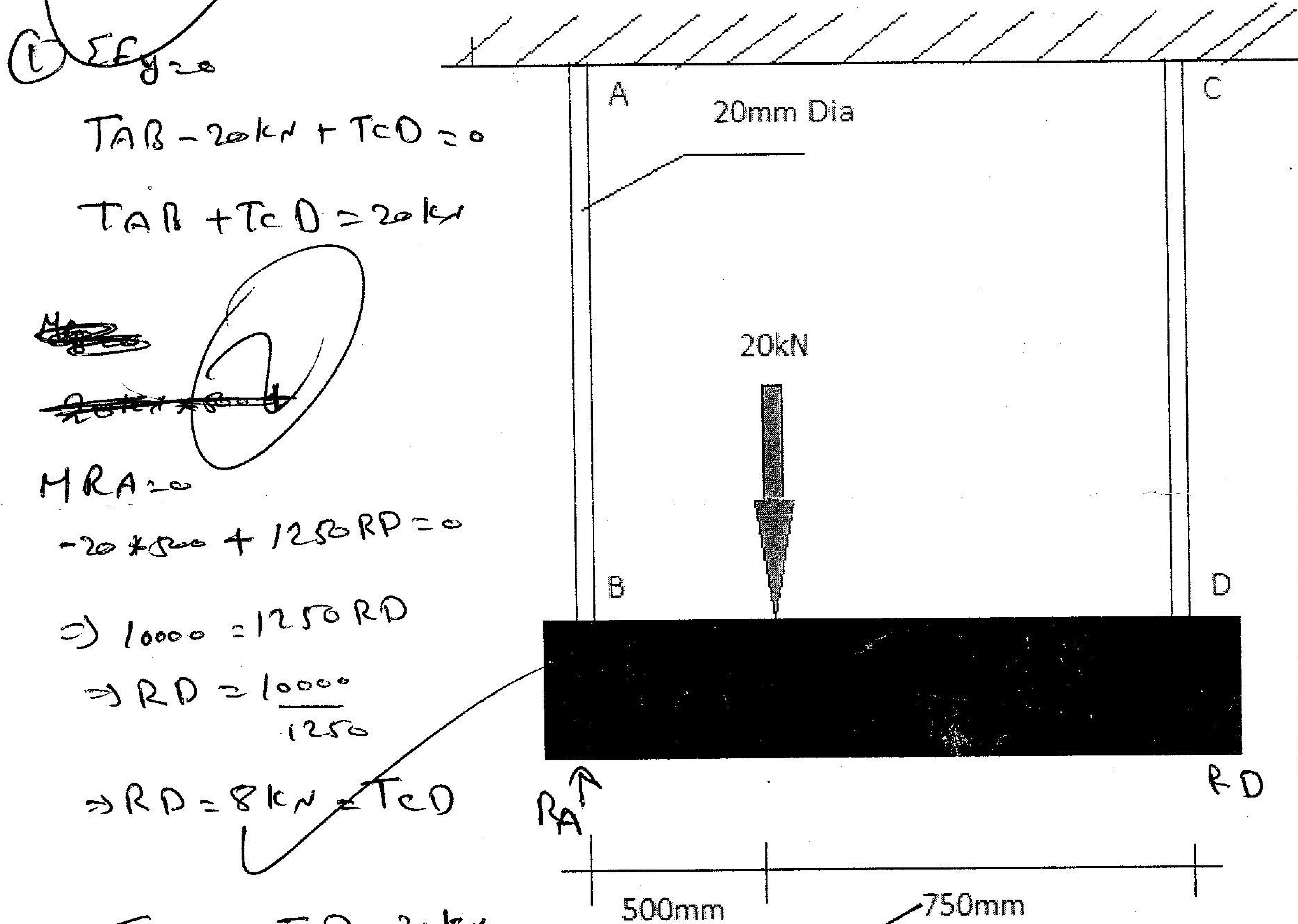
Department of Mechanical Engineering

Student Name [redacted] Roll number

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Question One: For the figure shown Determine:

1. The tensile force in cables AB and CD?
2. The Tensile normal stress in cable AB?
3. If the allowable tensile normal Stress in cable CD is 30MPa, determine its required diameter?



(1) $\Sigma F_y = 0$

$T_{AB} - 20kN + T_{CD} = 0$

$T_{AB} + T_{CD} = 20kN$

$M_{RA} = 0$

$-20 * 500 + 1250 R_D = 0$

$\Rightarrow 10000 = 1250 R_D$

$\Rightarrow R_D = \frac{10000}{1250}$

$\Rightarrow R_D = 8kN = T_{CD}$

R_A R_D

$T_{AB} + T_{CD} = 20kN$

$T_{AB} + 8kN = 20kN \Rightarrow T_{AB} = 12kN$

(2) 1.5

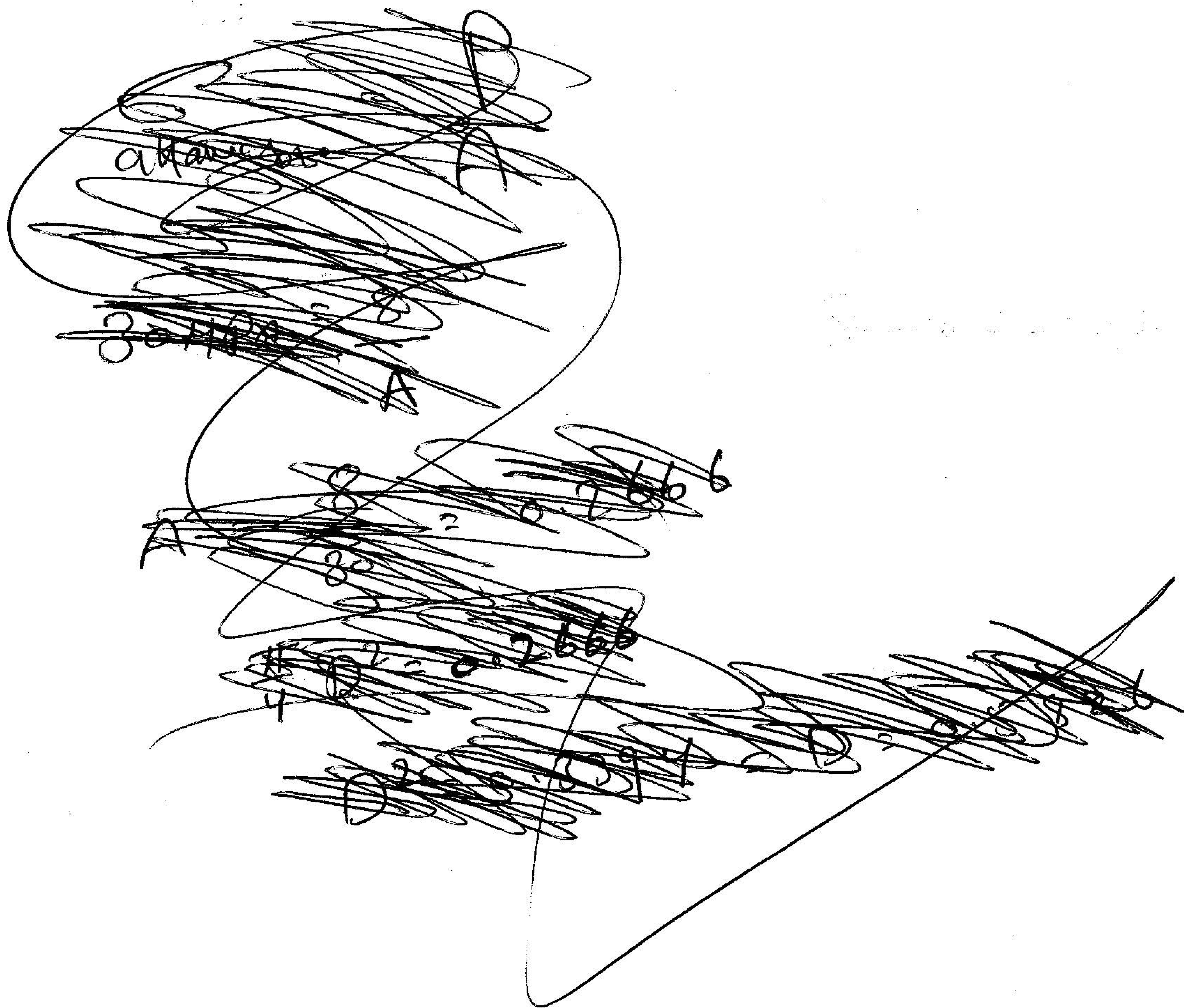
$\sigma_{AB} = \frac{P}{A} = \frac{12kN \times 10^3}{\frac{\pi}{4}(20)^2} = \frac{12000}{314.16} = 3.82$ MPa/mm²

حل الورقة

(3) [crossed out]

قوة مواد
امتحان اول

تم الرفع
بواسطة
م.معن البوعيسي



(3) الفرع الأول

$30 MPa = \frac{8\ kN}{A}$

(1.5)

$30 MPa = \frac{8 \times 10^3}{A}$

$30 MPa \times A = 8 \times 10^3$

$A = \frac{8 \times 10^3}{30} = 266.67$

$\Rightarrow \frac{\pi}{4} D^2 = 266.67$

$0.785 D^2 = 266.67$

$\Rightarrow D^2 = 339.53 \Rightarrow D = \sqrt{339.53}$

$= 18.426\ mm$

(2)

B

Question Two: For the steel plate shown determine:

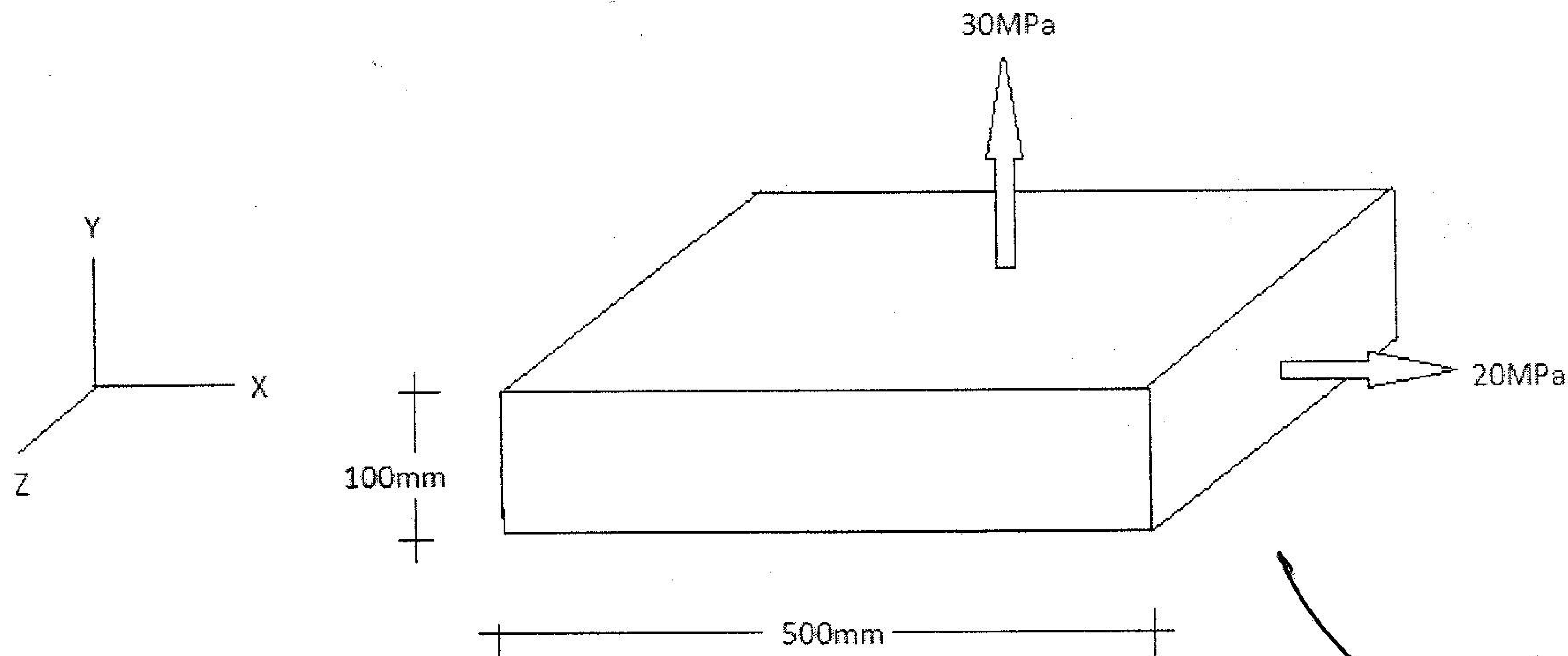
1. The deformation of plate in X direction?
2. The deformation of plate in Y direction?

Assume elastic behavior. Consider the shear modulus G= 70Gpa and the passion's ratio υ=0.3.

$G = \frac{E}{2(1+\upsilon)}$

$70*10^3 = \frac{E}{2(1+0.3)}$

$E = 182*10^3$



$\varepsilon_x = \frac{1}{70*10^3}(20MPa - \upsilon(30MPa + 0))$

$= 1.4286*10^{-5}(20MPa - 0.3(30))$

$= 1.4286*10^{-5}(11) = 1.57146*10^{-4}$

the deformation in x direction =

$1.57146*10^{-4} * 500 = 0.078573$ mm

$\varepsilon_y = \frac{1}{70*10^3}(30 - 0.3(20 + 0))$

$= 1.4286*10^{-5}(30 - 6)$

$= 1.4286*10^{-5} * 24 = 3.42864*10^{-4}$

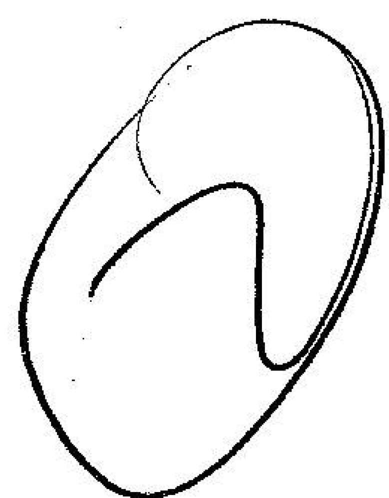
The deformation in y direction

$= 3.42864*10^{-4} * 100 = 0.0342864$ mm.

The deformation in direction x

$$\varepsilon_x = \frac{1}{E}\left(\sigma_x - \upsilon(\sigma_y + \sigma_z)\right)$$

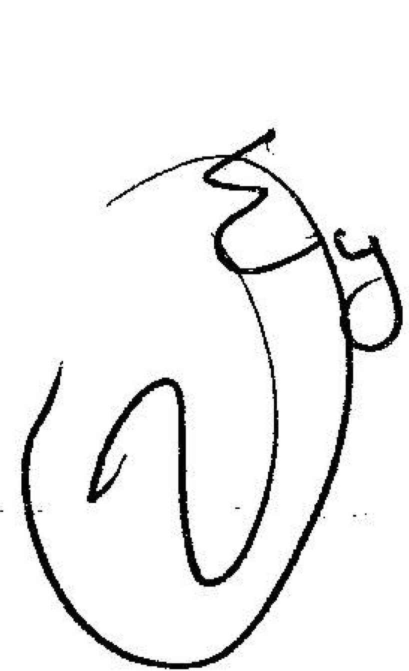
$$= \frac{1}{182*10^3}\left(20 - 0.3(30+0)\right)$$



$$= 5.4945*10^{-6}(11) = 6.044*10^{-5}$$

The deformation in x direction =

$$6.044*10^{-5}*500 = 0.03022 \text{ mm.}$$



$$\varepsilon_y = \frac{1}{182*10^3}\left(30 - 0.3(20+0)\right)$$

$$= 5.4945*10^{-6}(24) = 1.31868*10^{-4}$$

The deformation in y direction

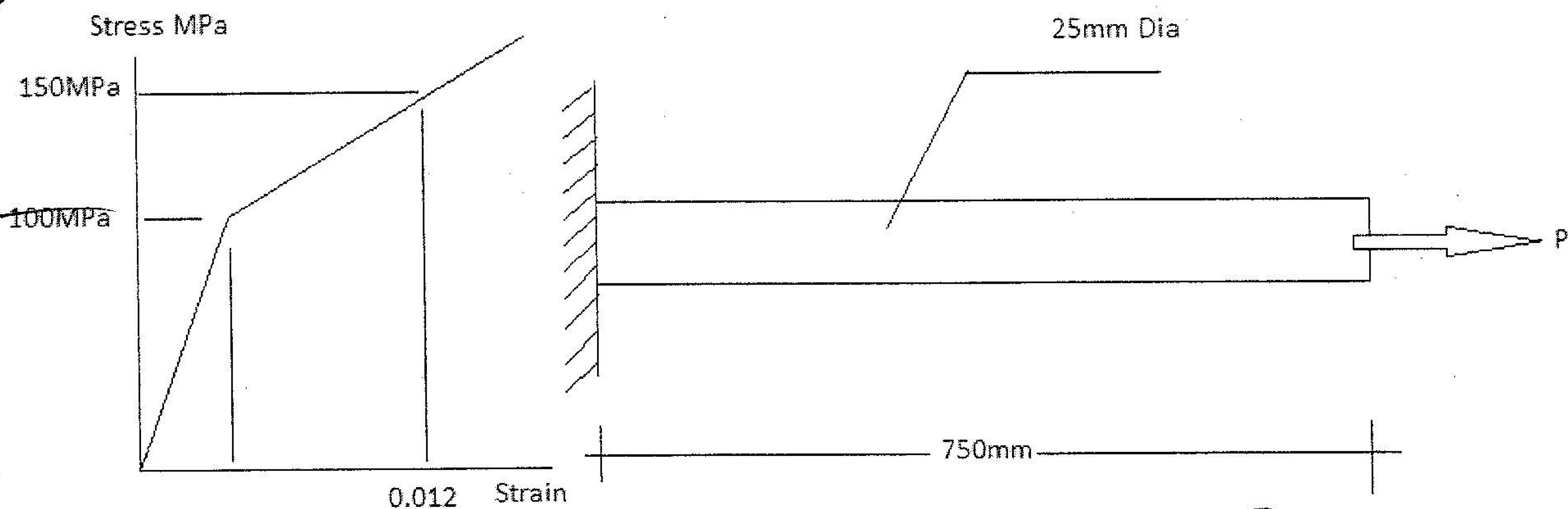
$$= 1.31868*10^{-4}*100 = 0.0131868 \text{ mm.}$$

Question Three: For the figure shown; determine

1. The deformation of the bar if P =20kN.
2. The deformation of the bar if the load is increased to P =73.63kN.
3. The deformation of the bar when P =73.63kN is removed?

Consider E=70GPa

5/5



12×10^{-3}

(1) $\sigma = \frac{20 \times 10^3}{\frac{\pi}{4}(25)^2} = \frac{20000}{490.87} = 40.79$ MPa. Less than 100MPa

So its behaviour is elastic

1.5

$\sigma = E\varepsilon$

$40.74\ MPa = 70 \times 10^3\ \varepsilon \Rightarrow \varepsilon = \frac{40.74}{70 \times 10^3} = 5.82 \times 10^{-4}$

the deformation in the bar $= 5.82 \times 10^{-4} \times 750 = 0.4365$ mm.

(2) $\sigma = \frac{73.63 \times 10^3}{\frac{\pi}{4}(25)^2} = \frac{73.63 \times 10^3}{490.87} = 150$ MPa. Plastic behaviour.

1.5

$\varepsilon = 0.012 = 12 \times 10^{-3}$

the deformation then $= 12 \times 10^{-3} \times 750 = 9$ mm.

$\Delta L = 9.4365$ mm.

التكملة خلف الورقة

③ The ~~deformation~~ P is moved.

$\varepsilon_{recovery} = \frac{180}{70 * 10^3} = 2.1429 * 10^{-3}$

$\Delta = (12*10^{-3} - 2.1429*10^{-3}) * 750 = 7.393$ mm.

when P is moved.

Question Four: Draw the Bending Moment Diagram BMD for the beam shown? The shear force diagram is drown.



10kN

5kN/m

7.5kN 4m 22.5kN 1m

S.F.D

7.5 10 10

2.5

1.5 m

-12.5

$\frac{12.5}{4-x} = \frac{7.5}{x}$

$12.5x = 30 - 7.5x$

$20x = 30 \Rightarrow x = 1.5m$

5.625

curve curve

0 1.5 2.5

-10 liner

